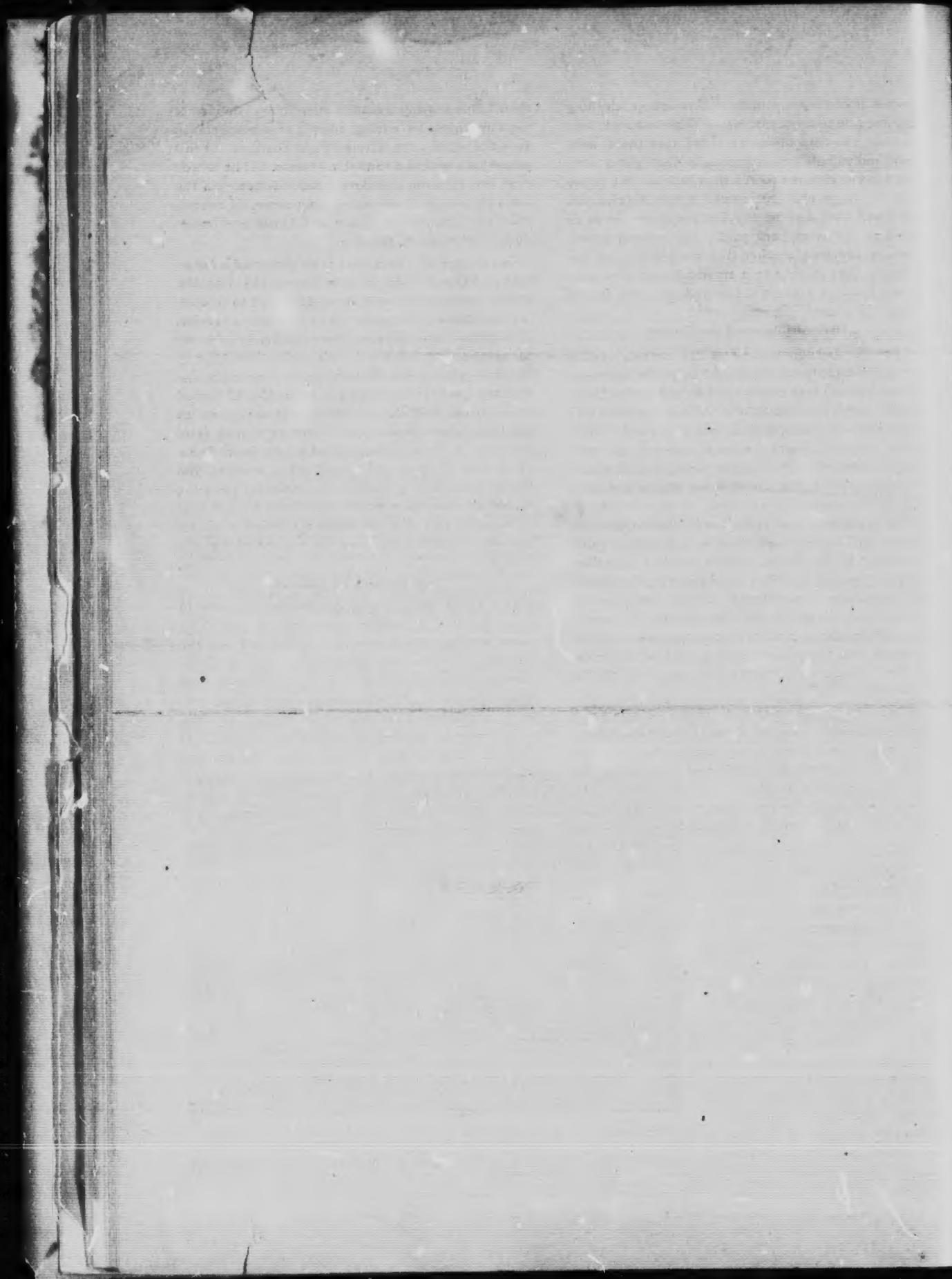






Chippawa Power Development in all Phases is a Higher Efficiency Enterprise

**Canada's Largest Piece of Construction Being
Carried Through by a Unified Organization, Work-
ing with Equipment of Record Breaking Order**

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THE development of industry is quite largely a matter of dependable and cheap power. Coal, except in the immediate vicinity of the mine, does not produce cheap power. Further, its supply is limited and uncertain and constantly increasing in price, due to increased cost in labor and transportation over which, except in a very general way, we have no control.

We fall back then, necessarily, on our water power, of which fortunately we have a large supply. Water power is never-failing, inexhaustible over any term of years, subject in only a minor way to increased costs of other commodities and, finally, ideally capable of application to manufacturing and construction industries of every kind.

It follows, then, that if Canada is to become a nation of efficient workers, in any or all lines of industrial life, our water powers must be utilized to their fullest extent.

That is the reason a description of the great Chippawa power development of the Hydro-electric Power Commission of Ontario finds its proper place in this "Higher Efficiency" number of the "Contract Record."

To begin with, this big development was undertaken so that two (and more) horsepower may be developed out of the same water which up to the present time has developed only one horsepower—that is higher efficiency at its best. Further, it is being put through at a time when many people entertain anticipations of a coal shortage and at the moment when young Canada (industrial) is upon the very threshold of an era of wonderful development. A third reason why a description of this work finds a place in our efficiency issue is found in the fact that this whole gigantic enterprise is being carried through as a unit, the same engineers and officers controlling the whole work, all plans being laid with a view to dovetailing in the various sections of the work—a condition that would be impossible if work on the different sections were being carried forward by different contractors. In a word, the work is one big organized unit, allowing of no duplications. This again spells greatest efficiency.

Thirteen-Mile Canal

The route of the big canal which will carry the water to the turbines at Queenston is shown in the map herewith. This route is about 12½ miles long, with the intake on the Niagara River at Hog Island, Chippawa, about two miles above Niagara Falls. The tailrace is on the Niagara River about one mile above Queenston. The intake will be in what is known as the Grass Island Pool of the Niagara River. The mean monthly elevation of this pool varies about one foot.

The normal mean elevation of Lake Erie is 573 feet; of Grass Island Pool, 563; of the proposed power house site, 247; and of Lake Ontario, 245. Probably no river has a more uniform regimen than the Niagara. The minimum flow is about half the maximum,

and over a period of fifty years the maximum difference in mean monthly levels under normal conditions, either at Queenston or Chippawa, amounts to only about six feet.

The best intake and power house locations were first determined upon, with a view to the maximum utilization of the available head, and contours and borings were then studied to decide by what route a canal could connect those two points to the best hydraulic and economic advantage. The intake was located at Hog Island partly on account of that point being just above the place at which the water begins to speed its passage over the Falls. Location further downstream would have meant a larger canal and a longer tailrace. Another reason equally important for the location of the intake at Chippawa was the use which could be made of the natural channel of the Welland River—often called Chippawa Creek—which comprises about 4¼ miles of the route of the Canal, leaving only about 8½ miles to be excavated, although the Welland River will have to be somewhat deepened. The flow of the Welland River, which is a sluggish stream with a very flat gradient, will be reversed for this 4¼ miles.

8½ Miles of Excavation

This 8½ miles of excavated section compared with 19½ miles for the old Jordan-Erie scheme, and the net head is 305 feet, compared with a possible 299 feet for the Jordan-Erie project. (see map)

The gradients adopted for the canal average about one foot per mile, or a total of about eight feet in the 8½ miles of excavated canal. The loss of head in the penstocks, due to friction, may amount to upwards of two and a half feet, and the loss in the Welland River from Hog Island to Montrose, where the excavated canal begins, will be about 6 inches, under maximum load, so that the total loss of head will be about 11 feet, making the net effective head about three hundred and five feet under normal conditions.

Thus, of the 327 feet normal difference in level between the two lakes, only 22 feet head will be lost—10 feet between Lake Erie and Hog Island, 11 feet between the intake and the tailrace, and two feet between the point of discharge of the tail water and Lake Ontario.

The power house will be located in the bottom of the gorge, about three-quarters of a mile above the Lewiston Bridge, just below where the last rough water disappears. The cliffs are nearly vertical at this point, and as the gatehouse will be on the cliff immediately above the power house, the penstocks will be nearly vertical and only about 450 feet long, thus reducing cost and head loss to a minimum.

With this scheme of development about 30 h.p. will be obtained from each second-foot of water used, compared with about 14 h.p. per second-foot obtained by the existing plants at Niagara Falls. With

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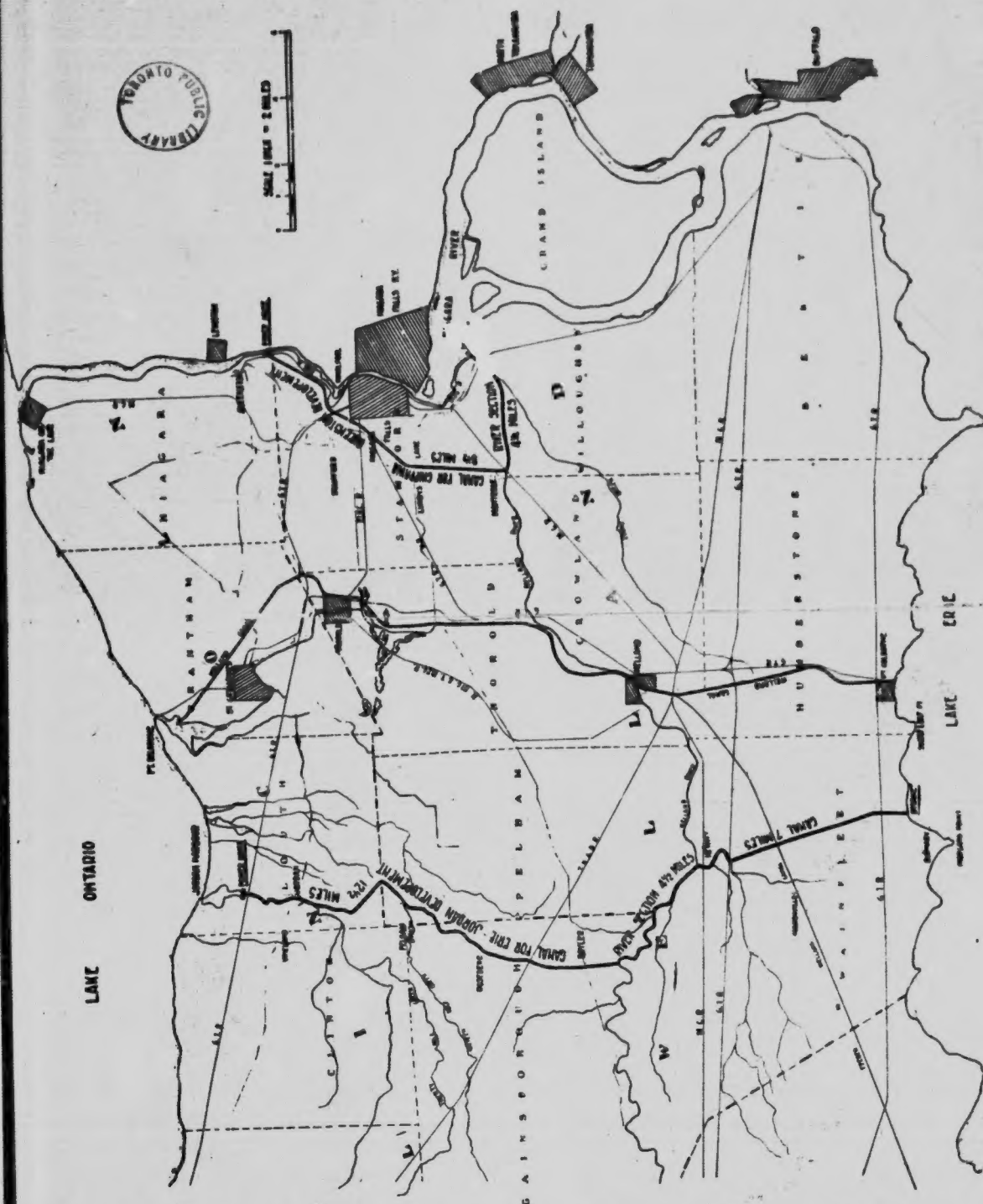
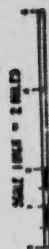
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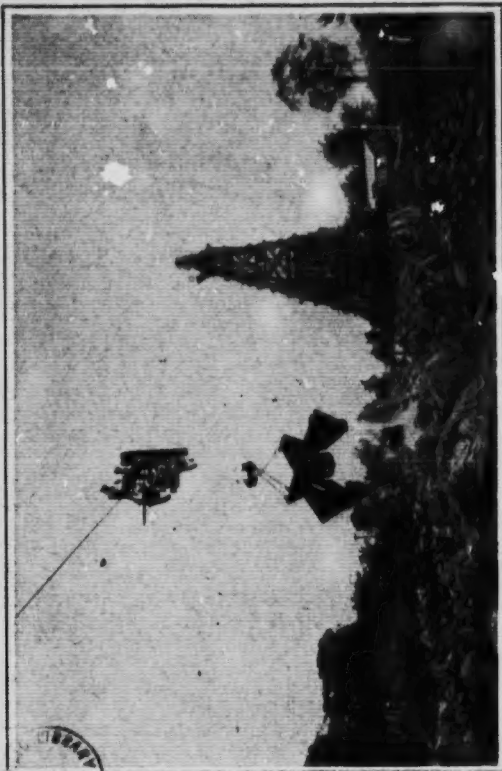
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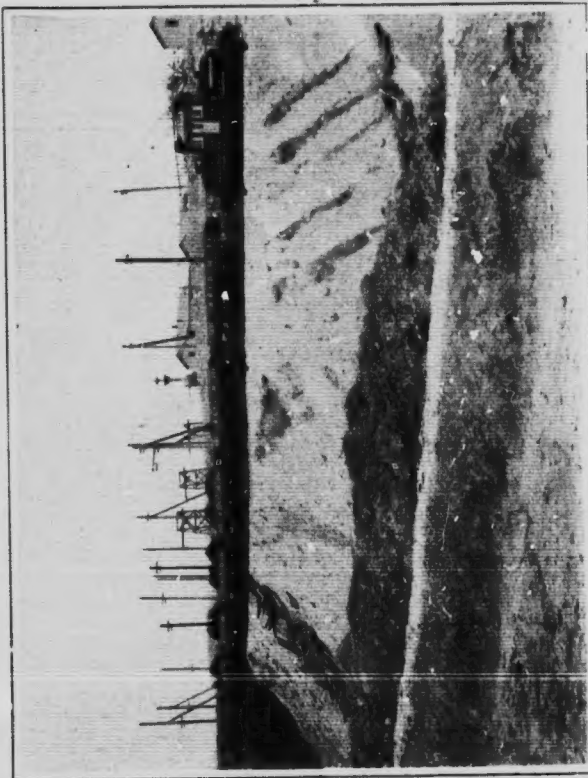
Map showing the general route of the Queenston development canal, four and a quarter miles up Welland River, eight and a half miles rock and earth cut. Compare Erie-Jordan route with nineteen and a half miles cut



Excavation east from Bowman's Ravine late in 1918



Dredging Welland River—bucket dumping. Load about 3 yards

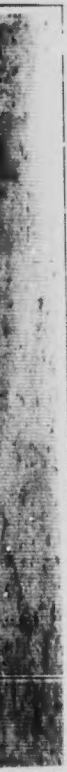


An electric locomotive and train of 20-yard dump cars. The usual train is 18 cars

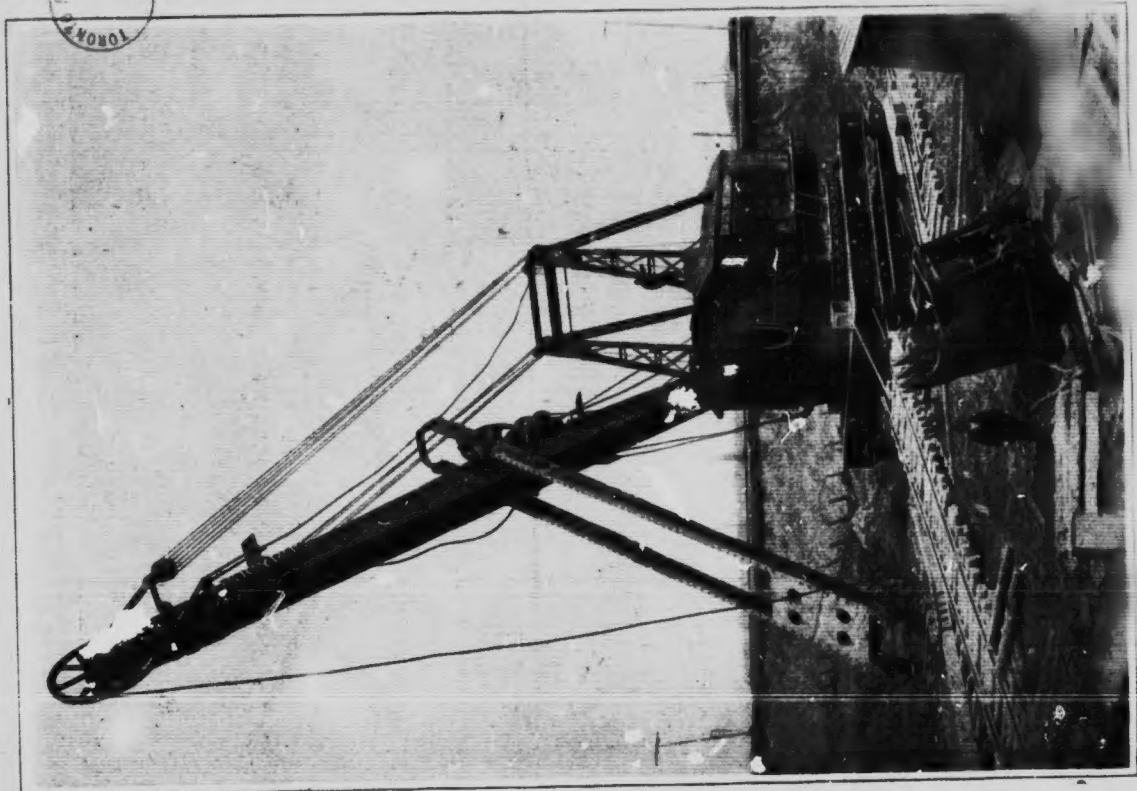


Bucyrus in act of dumping 8 tons of earth

An electric locomotive and train of 20-yard dump cars. The usual train is 10 cars

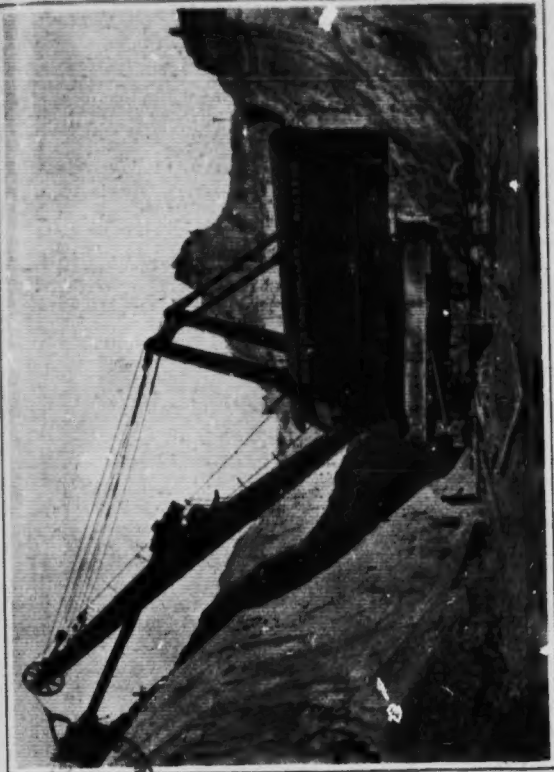


Bucyrus in act of dumping 8 tons of earth



Assembling one of the big Bucyrus shovels

Lifts 8 to 10 cubic yards



Bucyrus shovel lifting 8 cubic yards of earth and loading cars 10 feet above



Big Bucyrus shovel loading cars, 8 tons at a time

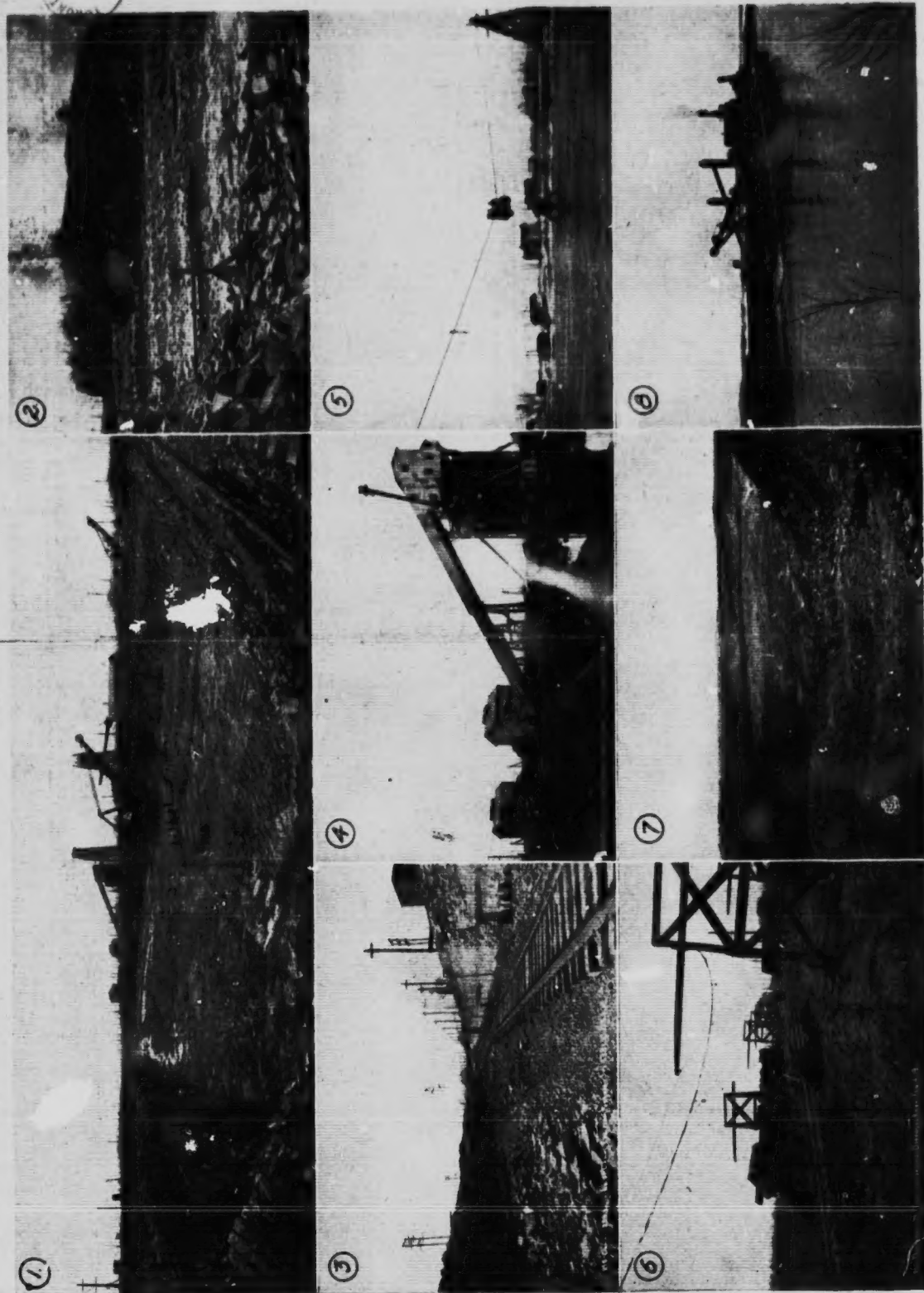


Fig. 1. View of forebay taken from electric railway track which rents on the immediate crest of the bank above the proposed site of the power plant at Quanaan—solid rock, showing about 25 feet in depth excavated. (1) View of forebay immediately following shot. (2) Looking up canal excavation from forebay. (3) Looking up canal excavation from forebay. (4) Looking up canal excavation from forebay. (5) Looking up canal excavation from forebay. (6) Looking up canal excavation from forebay. (7) Looking up canal excavation from forebay. (8) Looking up canal excavation from forebay.

Rock Section

The surveys for the work were begun in 1914 and continued for nearly two years. During the year 1917 the construction plant was brought onto the job and assembled, and during the first part of 1918 the camps were completed.

The Three Largest Shovels Ever Built

On the Welland River section of the canal, a Lidgetterwood cable excavator is at work, fitted with a 3-cubic-yard Anderson-Evans clam. The cableway has an 80-foot head tower and 60-foot tail tower, and a

15,000,000 Cubic Yards of Excavation

At the present time the material which is being

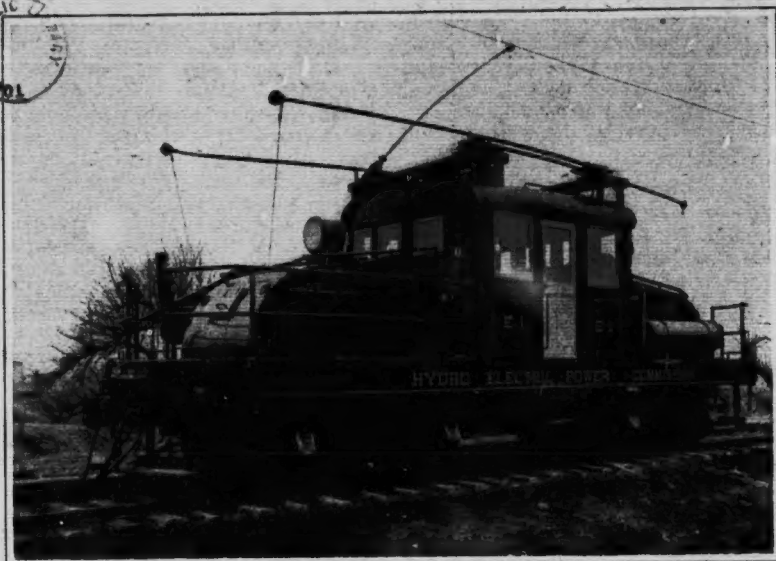


Centering for one of the concrete bridges over the Chippawa power canal

Framed timber trestles are set alongside the dump and other temporary tracks to carry the trolley wire. These trestles are mounted on wheels or skids and can

Fig. 1. View of forðar takes from electric railway track which rests on the immediate crest of the bank above the proposed site of the power plant at Quæntun—solid rock, showing about 25 feet in an depth excavated. (1) View of forðar immediately following shot. (2) View of forðar immediately following secondary crushers, and finally hoisted to the screen house on the extreme right of the structure (3) Disposal area, showing the cable bucket in operation on belt conveyor with the 3-ton load; this bucket makes a trip every 2 minutes. (4) Large disposal area, allowing load being dumped into the railway pole line. (5) Another view of disposal area, showing the 3-ton load being unloaded. (6) Dredging work under way at Hog Island, at entrance to Wheland river; screen in distance being unloaded.

PUBLIC



One of the electric locomotives. Note the double trolley arrangement, two poles on each side

be removed readily by a locomotive crane when it is necessary to shift the track.

In the Whirlpool yards is located a large repair shop containing drills, shapers, planers, lathes, forges, steam-hammers and wood-working machines. The Commission has built about eighty buildings, including bunk houses, freight houses, offices, machine shop, storehouses, substation, etc.; also a number of buildings are used which were on various parcels of purchased property.

Gunite Buildings

Most of the buildings are of frame construction, but are being "gunited" on the outside over tar paper and wire mesh, using 1 to 3 mix of cement and sand. Sharp concrete sand is being used and the "gunite" applied with cement-guns. The substation, machine shop and all of the more important buildings have already been fireproofed in this manner, and it is the intention to "gunite" most of the other buildings. The bunkhouses are comfortably arranged on the cottage plan.

The crushing plant is located on the forebay. It is equipped with three secondary crushers of the gyratory type and one 84 in. x 60 in. Taylor jaw

crusher which will have a minimum capacity of 2,000 cubic yards of crushed stone per day.

The rock excavation at the forebay is loaded into skips which are picked up by a locomotive crane and which dump into a bin. A belt conveyor carries the stone from the bin to the crushers and from thence by another conveyor to the cars.

There are four railway bridges to be constructed over the canal, one for the Niagara, St. Catharines and Toronto Railway (electric), one for the Wabash Railroad, one for the Michigan Central Railroad, and one for the Grand Trunk and Michigan Central Railroads. These will be reinforced concrete arch bridges. There will also have to be constructed a number of highways and foot bridges to carry the various roads across the canal. In the concrete work to date, both Canada and St. Mary's cement have been used.

Several hydraulic models are being prepared at Dufferin Islands, near the Ontario Power Company's intake in the Niagara River. These models are based on designs prepared by the Commission and are for the purpose of studying the design of the intake at Hog Island. The design of the intake works will be based upon the results of these studies.